

CLAIMS

What is claimed is:

1. An optical analysis system for analyzing a molecular component in a gas, liquid, or solid, the system comprising:

5 a laser emitting light at a predetermined wavelength in the near-infrared spectrum which corresponds to an absorption feature of the molecular component being analyzed;

a light amplifier optically coupled to and receiving the light from the laser, wherein the light amplifier emits amplified light at the predetermined wavelength; and

10 optical analysis means optically coupled to and receiving the amplified light from the fiber amplifier.

2. The system of claim 1, wherein the near-infrared spectrum consists of light having wavelengths between 700 nm and 3000 nm.

3. The system of claim 1 further comprising an optical fiber disposed between and optically coupling the laser and the light amplifier.

15 4. The system of claim 1 further comprising an optical fiber disposed between and optically coupling the light amplifier and the optical analysis means.

5. The system of claim 1, wherein the light amplifier comprises a fiber amplifier.

20 6. The system of claim 1, wherein the light amplifier comprises a semiconductor optical amplifier.

7. The system of claim 1, wherein the optical analysis means comprises a photoacoustic spectrometer.

8. An optical analysis system for analyzing one or more molecular components in a gas, liquid, or solid, the system comprising:

5 a plurality of lasers emitting light at one or more predetermined wavelengths in the near-infrared spectrum, wherein each of the predetermined wavelengths corresponds to an absorption feature of the one or more molecular components being analyzed;

10 a multiplexor optically coupled to and receiving the light from the plurality of lasers, wherein the multiplexor combines the light from the plurality of lasers and emits the light into a single optical path;

15 a light amplifier optically coupled to and receiving the light from the single optical path, wherein the light amplifier emits amplified light at the one or more predetermined wavelengths; and

20 optical analysis means optically coupled to and receiving the amplified light from the fiber amplifier.

9. The system of claim 8, wherein the near-infrared spectrum consists of light having wavelengths between 700 nm and 3000 nm.

10. The system of claim 8 further comprising a plurality of optical fibers disposed between and optically coupling the plurality of lasers and the multiplexor.

11. The system of claim 8 further comprising an optical fiber disposed between and optically coupling the multiplexor and the light amplifier.

12. The system of claim 8 further comprising an optical fiber disposed between and optically coupling the light amplifier and the optical analysis means.

13. The system of claim 8, wherein the light amplifier comprises a fiber amplifier.

5 14. The system of claim 8, wherein the light amplifier comprises a semiconductor optical amplifier.

15. The system of claim 8, wherein the optical analysis means comprises a photoacoustic spectrometer.

16. An optical gas analysis system for analyzing a molecular component in a gas comprising:

a laser emitting light at a predetermined wavelength in the near-infrared spectrum which corresponds to an absorption feature of the molecular component being analyzed;

a fiber amplifier optically coupled to the laser using a first optical fiber, wherein the fiber amplifier receives the light and emits amplified light at the predetermined wavelength in the near-infrared spectrum which corresponds to an absorption feature of the molecular component being analyzed; and

photoacoustic analysis equipment optically coupled to the fiber amplifier using a second optical fiber, wherein the photoacoustic analysis equipment receives and utilizes the amplified light at the predetermined wavelength to perform analyses of the molecular component.

17. The system of claim 16, wherein the near-infrared spectrum consists of light having wavelengths between 700 nm and 3000 nm.

18. The system of claim 16, wherein the fiber amplifier comprises a rare-earth-doped fiber amplifier.

19. An optical analysis system for analyzing a molecular component in a gas comprising:

5 a fiber laser emitting amplified light at a predetermined wavelength in the near-infrared spectrum which corresponds to an absorption feature of the molecular component being analyzed; and

optical analysis means optically coupled to the fiber laser using an optical fiber, wherein the optical analysis means receives and utilizes the amplified light at the predetermined wavelength to perform analyses of the molecular component.

20. The system of claim 19, wherein the near-infrared spectrum consists of light having wavelengths between 700 nm and 3000 nm.

21. The system of claim 19, wherein the optical analysis means comprises a photoacoustic spectrometer.

22. A method of optically analyzing a molecular component in a gas, liquid, or solid, the method comprising:

generating, from a laser, light at a predetermined wavelength in the near-infrared spectrum which corresponds to an absorption feature of the molecular component being analyzed;

receiving the light at a light amplifier;

generating, from the light amplifier, amplified light at the predetermined wavelength;

receiving the amplified light at optical analysis means; and

analyzing, with the optical analysis means, the molecular component using the amplified light.

23. The method of claim 22, wherein the near-infrared spectrum consists of light having wavelengths between 700 nm and 3000 nm.

5 24. The method of claim 22, wherein receiving the light at the light amplifier includes guiding the light through an optical fiber from the laser to the light amplifier.

25. The method of claim 22, wherein receiving the light at the optical analysis means includes guiding the light through an optical fiber from the light amplifier to the optical analysis means.

26. The method of claim 22, wherein the light amplifier comprises a fiber amplifier.

27. The method of claim 22, wherein the light amplifier comprises a semiconductor optical amplifier.

28. The method of claim 22, wherein the optical analysis means comprises a photoacoustic spectrometer.

29. A method of optically analyzing molecular components in a gas, liquid, or solid, the method comprising:

generating, from a plurality of lasers, light at one or more predetermined wavelengths in the near-infrared spectrum, wherein each of the predetermined wavelengths corresponds to an absorption feature of the one or more molecular components being analyzed;

receiving the light at a multiplexor;

combining the light from the plurality of lasers into a single optical path;

receiving the light from the single optical path with a light amplifier;
generating, from the light amplifier, amplified light at the one or more
predetermined wavelengths;

receiving the amplified light at optical analysis means; and
5 analyzing, with the optical analysis means, the molecular component using the
amplified light.

30. The method of claim 29, wherein the near-infrared spectrum consists of
light having wavelengths between 700 nm and 3000 nm.

31. The method of claim 29, wherein receiving the light at the light amplifier
includes guiding the light through an optical fiber from the plurality of lasers to the light
amplifier.

32. The method of claim 29, wherein receiving the light at the optical analysis
means includes guiding the light through an optical fiber from the light amplifier to the
optical analysis means.

33. The method of claim 29, wherein the light amplifier comprises a fiber
amplifier.

34. The method of claim 29, wherein the light amplifier comprises a
semiconductor optical amplifier.

35. The method of claim 29, wherein the optical analysis means comprises a
20 photoacoustic spectrometer.

36. A method of optically analyzing a molecular component in a gas
comprising:

generating, from a laser, light at a predetermined wavelength in the near-infrared spectrum which corresponds to an absorption feature of the molecular component being analyzed;

guiding the light through a first optical fiber to a fiber amplifier;

5 generating, from the fiber amplifier, amplified light at the predetermined wavelength;

guiding the amplified light through a second optical fiber to photoacoustic analysis equipment; and

analyzing, with the photoacoustic analysis equipment, the molecular component using the amplified light.

37. The method of claim 36, wherein the near-infrared spectrum consists of light having wavelengths between 700 nm and 300 nm.

38. The method of claim 36, wherein the light amplifier comprises a rare-earth-doped fiber amplifier.

39. A method of optically analyzing a molecular component in a gas comprising:

sub
a, generating, from a fiber laser, amplified light at a predetermined wavelength in the near-infrared spectrum which corresponds to an absorption feature of the molecular component being analyzed; a

20 guiding the amplified light through an optical fiber to optical analysis means; and

analyzing, with the optical analysis means, the molecular component using the amplified light.

light having wavelengths between 700 nm and 300 nm.

photoacoustic spectrometer.

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